Problem Set 12

1. A simple hologram is made as follows: The object is a single narrow white strip located a distance z from the recording plate. The plate is illuminated at normal incidence by a reference laser beam of wavelength λ, which also illuminates the strip. Show that the resulting pattern on the hologram is a one-dimensional grating with a variable spacing s in the y direction, where y lies in the plane of the plate and is perpendicular to the strip. Give the numerical values of s for $z = 10$ cm and $\lambda = 633$ nm, for various values of y: 0, 1, 2, and 4 cm.

2. Referring to the previous problem, show in detail how, if the hologram is illuminated by the reference laser in the same way, two diffracted beams will emerge: one producing a real image of the strip, the other producing a virtual image. The second beam appears to diverge from a line corresponding to the original object, while the first converges toward a real image located symmetrically at $-z$ on the opposite side of the plate. Find the actual angles of diffraction for the various values of y given in the previous problem. Will there be second-order (or even higher-order) diffracted beams?

3. Pedrotti×2 13-1.

4. Pedrotti×2 13-12.

5. Pedrotti×2 22-1.

6. Pedrotti×2 22-11.

7. Pedrotti×2 22-15.

8. Pedrotti×2 22-17.